WE CLAIM:

1. A method of digitally encoding speech, comprising generating an excitation function, said excitation function comprising a number of non-zero pulses separated by spaces therebetween; and computing a synthesized speech in response to said non-zero pulses and not computing a contribution of said spaces.

2. The method according to Claim 1, further comprising optimizing roots of a synthesis filter polynomial using an iterative root optimization algorithm in response to said computed synthesized speech.

3. The method according to Claim 1, wherein said pulses are non-uniformly spaced.

4. The method according to Claim 1, wherein said pulses are uniformly spaced.

5. The method according to Claim 1, wherein said excitation function is generated using a linear prediction coding ("LPC") encoder.

6. The method according to Claim 1, wherein said excitation function is generated using a multipulse encoder.

7. The method according to Claim 1, wherein said spaces comprise no pulses.

8. The method according to Claim 1, wherein said excitation function is generated within an analysis frame comprising a plurality of speech samples; and wherein said synthesized speech is computed in response to said samples which comprise at least one of said pulses and not in response to said samples which comprise none of said pulses.

9. The method according to Claim 1, wherein said synthesized speech is calculated using the formula:

$$\hat{s}(n) = h(n)*u(n) = \sum_{k=1}^{F(n)} h(n-p(k))u(p(k)).$$

10. The method according to Claim 9, wherein said synthesized speech is further calculated using the formula:

$$\hat{s}(n) = \sum_{k=0}^{n} h(k)u(n-k) = \sum_{k=1}^{F(n)} u(p(k)) \sum_{i=1}^{M} b_i(\lambda_i)^{n-p(k)}$$

where said excitation function is defined by the formulas:

$$u(p(k)) \neq 0 \quad \text{for} \quad k = 1,2\ldots N_p$$

$$u(n) = 0 \quad \text{for} \quad n \neq p(k)$$

and where F(n) is defined by the formulas:

$$p(F(n)) \leq n$$

$$F(n) \leq N_p.$$

11. The method according to Claim 10, further comprising computing roots of a synthesis polynomial using the formula:

$$\partial\hat{s}(k)/\partial\lambda_r^{(j)} = b_r \sum_{m=1}^{F(k)} (k-p(m))u(p(m))(\lambda_r^{(j)})^{(k-p(m)-1)}.$$

12. The method according to Claim 1, wherein said synthesized speech computation comprises calculating a convolution of an impulse response and said excitation function; and wherein said spaces comprise no pulses.

13. The method according to Claim 12, wherein said excitation function is generated within an analysis frame comprising a plurality of speech samples; wherein said synthesized speech is computed in response to said samples which comprise at least one of said pulses and is not computed in

response to said samples which comprise none of said pulses; and wherein said synthesized speech is calculated using the formula:

$$\hat{s}(n) = h(n)*u(n) = \sum_{k=1}^{F(n)} h(n-p(k))u(p(k)).$$

14. The method according to Claim 13, wherein said pulses are non-uniformly spaced; and wherein said excitation function is generated using a multipulse encoder.

15. The method according to Claim 14, further comprising optimizing roots of a synthesis polynomial using an iterative root searching algorithm in response to said computed synthesized speech.

16. A method of digitally encoding speech, comprising producing a series of pulses, adjacent pulses defining a space therebetween; and computing a synthesis polynomial, said computing comprising calculating a contribution of said pulses and not calculating a contribution of said space.

17. The method according to Claim 16, wherein said synthesis polynomial computation comprises calculating a convolution of an impulse response and an excitation function; wherein said excitation function is generated within an analysis frame comprising a plurality of speech samples; and wherein said synthesis polynomial is computed in response to said samples which comprise at least one of said pulses and is not computed in response to said samples which comprise none of said pulses; and further comprising optimizing roots of said synthesis polynomial using an iterative root optimization algorithm.

18. The method according to Claim 17, wherein said synthesis polynomial is calculated using the formula:

$$\hat{s}(n) = h(n)*u(n) = \sum_{k=1}^{F(n)} h(n-p(k))u(p(k))$$

where said excitation function is defined by the formulas:

$$u(p(k)) \neq 0 \quad \text{for} \quad k = 1,2\ldots N_p$$

$$u(n) = 0 \quad \text{for} \quad n \neq p(k)$$

and where F(n) is defined by the formulas:

$$p(F(n)) \leq n$$

$$F(n) \leq N_p .$$

19. A speech synthesis system, comprising an excitation module responsive to an original speech and generating an excitation function, said excitation function comprising a series of pulses; and a synthesis filter responsive to said excitation function and said original speech and generating a synthesized speech; wherein said synthesis filter computes a convolution of an impulse response and said excitation function, said convolution computation comprising calculating samples of speech having at least one of said pulses and not calculating samples of speech having none of said pulses.

20. The method according to Claim 19, wherein said synthesis filter computes roots of a synthesis polynomial using the formula:

$$\partial\hat{s}(k)/\partial\lambda_r^{(j)} = b_r \sum_{m=1}^{F(k)} (k-p(m))u(p(m))(\lambda_r^{(j)})^{(k-p(m)-1)}.$$

21. The method according to Claim 19, wherein said convolution computation is calculated using the formula:

$$\hat{s}(n) = \sum_{k=0}^{n} h(k)u(n-k) = \sum_{k=1}^{F(n)} u(p(k)) \sum_{i=1}^{M} b_i(\lambda_i)^{n-p(k)}$$

where said excitation function is defined by the formulas:

$$u(p(k)) \neq 0 \quad \text{for} \quad k = 1,2 \ldots N_p$$

$$u(n) = 0 \quad \text{for} \quad n \neq p(k)$$

and where F(n) is defined by the formulas:

$$p(F(n)) \leq n$$

$$F(n) \leq N_p .$$

22. The method according to Claim 19, wherein said convolution computation is calculated using the formula:

$$\hat{s}(n) = h(n)*u(n) = \sum_{k=1}^{F(n)} h(n-p(k))u(p(k))$$

where said excitation function is defined by the formulas:

$$u(p(k)) \neq 0 \quad \text{for} \quad k = 1,2 \ldots N_p$$

$$u(n) = 0 \quad \text{for} \quad n \neq p(k)$$

and where F(n) is defined by the formulas:

$$p(F(n)) \leq n$$

$$F(n) \leq N_p .$$

23. The method according to Claim 22, wherein said pulses are non-uniformly spaced.

24. The method according to Claim 22, wherein said pulses are uniformly spaced; and wherein said excitation function is generated using a linear prediction coding ("LPC") encoder.

25. The method according to Claim 22, further comprising a synthesis filter optimizer responsive to said excitation function and said

synthesis filter and generating an optimized synthesized speech sample; wherein said synthesis filter optimizer minimizes a synthesis error between said original speech and said synthesized speech; wherein said synthesis filter optimizer comprises an iterative root optimization algorithm; and wherein said iterative root optimization algorithm uses the formula:

$$\partial\hat{s}(k)/\partial\lambda_r^{(j)} = b_r \sum_{m=1}^{F(k)} (k-p(m))u(p(m))(\lambda_r^{(j)})^{(k-p(m)-1)}.$$